West Ranch Field

The HUMBLE WAY

JULY-AUGUST, 1945

The HUMBLE WAY

Vol. 1 JULY-AUGUST, 1945 No. 2

AFTER V-J DAY

Editor's Note: This article was written during July, 1945. Developments since then serve to emphasize the importance of the subject.

The Outlook for Crude Oil Production

H. C. WIESS, *President*
Humble Oil & Refining Company

THE postwar problems of the petroleum industry are sometimes dismissed lightly on the ground that no reconversion will be necessary since the industry can switch from military to civilian quality products overnight. This view fails to take into account the decline in demand that will occur at the conclusion of the war with Japan. The large adjustment required in crude oil production may involve even greater difficulties than will be experienced by industries that must convert but are assured of an immediate market for all their output.

Petroleum production has been expanded so greatly to meet war needs that a substantial decline is inevitable after V-J Day. The average consumer of gasoline and heating oil, since he is now using less than before the war, probably does not realize that the supply of refined products actually is far greater than ever before. Such shortages of petroleum products as exist for civilian consumers are due to the substantial proportion of the total supply required for military purposes. In spite of the great increase in crude oil output, military requirements have expanded so rapidly that it has been necessary to restrict civilian consumption in order to supply all that the armed forces needed. Fortunately, the oil industry is able to say that no military operations have been handicapped to date by its failure to supply refined products.

OIL FOR WAR

The important role that petroleum has played in military operations is not generally recognized. It is a fact, however, that petroleum accounts for about 60 per cent of the military supplies shipped overseas. This is a war in which machines constitute the determining factor, and those machines require enormous quantities of gasoline, fuel oils, lubricating oils, and other special petroleum products. In testifying before a Senate Committee, a high ranking Army officer said: "The success of our armed forces in the present war has been achieved to a major extent by the use of engines of war driven by the products of petroleum."

The tremendous and highly successful operations of the Army, Navy, and Air Forces have required unprecedented quantities of petroleum. Oil has been the motive power for the Army in its lightning campaigns, for the Navy in its far flung operations that have practically freed the seas of enemy ships, and for the Air Forces in their mighty raids that have destroyed the industrial plants and paralyzed transportation in Germany and Japan. Petroleum Administrator Ickes pointed out last November that the United States was supplying more than 1,600,000 barrels daily for military purposes, or about one-third of the total domestic production. This included more than 800,000 barrels daily of all grades of gasoline, which is twenty times the motor fuel used by the military forces of the Allies in 1918. Although the war in Europe has ended, there are indications that the petroleum requirements of the armed forces have not been reduced substantially.

The dramatic expansion that has taken place in petroleum operations to meet war demands is indicated in the charts on the following pages. Crude oil production has been increased by more than 1,000,000 barrels daily, or 27 per cent since 1941. The additional oil for war has been provided primarily by Texas and California. The remainder of the United States has actually experienced a decline in output, reflecting the downward trend in Illinois and Oklahoma. Crude oil production in Texas now exceeds the average in 1941 by 800,000 barrels daily, or 60 per cent. California has increased 319,000 barrels daily, or 50 per cent, in the same period, while all other oil producing states together have shown a decline of 61,000 barrels daily. The changes in production for these areas during the past four years are shown in the following tabulation:

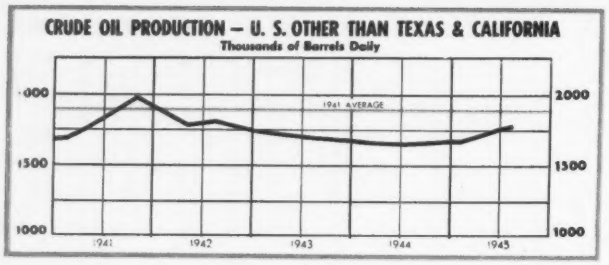
PRODUCTION—Barrels Daily

	Year 1941	3rd Quarter 1945	Change
Texas	1,385,000	2,185,000	+ 800,000
California	631,000	950,000	+ 319,000
Other U. S.	1,826,000	1,765,000	— 61,000
Total U. S.	3,842,000	4,900,000	+1,058,000

TRANSITION PERIOD

The Petroleum Administration has indicated in recent weeks that military demands for oil will continue at a high

DRILLER ON HUMBLE rig operating in Mississippi checks rock bit for wear before running drill stem back in the hole.



level during the period between V-E Day and V-J Day. The conclusion of the war in Europe did bring about some reduction in military demands for gasoline, thereby permitting the higher allocation to civilians. At the same time, however, requirements for fuel oil increased due to intensification of the war in the Pacific. In order to meet anticipated military demands, as well as civilian requirements on the basis of current rationing allowances, it may be necessary for the oil industry to maintain its high level of operations until V-J Day.

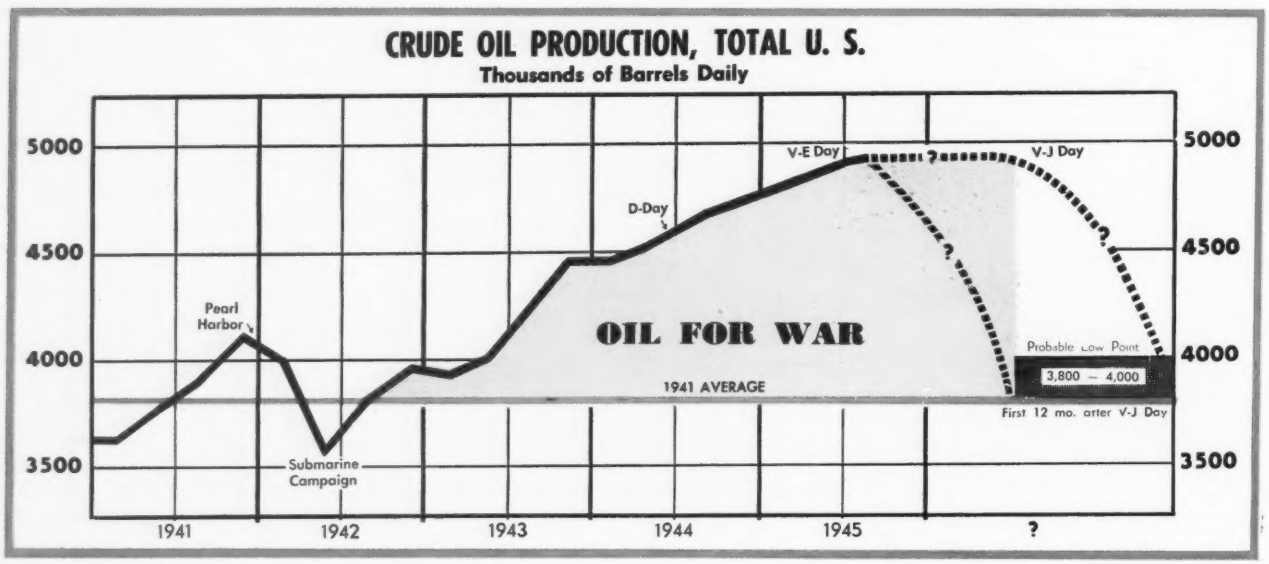
Such a prospect is disturbing because it may accentuate the shock that will be involved in adjusting to the level of postwar demands. The increase in production has occurred gradually over a period of four years, but the postwar decline will be compressed into a much shorter period. While the industry desires and intends to continue supplying all the oil needed for war, it hopes to have the cooperation of the military authorities in reducing demands gradually, insofar as practical, both during and after the war. Even if this is done, the adjustments within three to nine months after V-J Day will still be difficult.

Continued production at present rates means heavy withdrawals from developed reserves and is a serious matter in itself, apart from the added difficulty of more rapid adjustment that it will necessitate. It is apparent that discoveries are not keeping pace with the present level of output. Even on optimistic evaluations of current exploration efforts, it seems certain that the oil industry is not finding reserves equal to its current production. This is true in spite of expanded exploratory drilling and active development of proved areas. Even with the lower level of postwar production, it will be necessary for the industry to discover about 1,400,000,000 barrels of oil a year in order to maintain its present reserves. This will call for a large program of exploration and drilling that can be carried out only if the industry is able to maintain a sound position. The importance of adequate petroleum reserves for national security emphasizes the necessity of making the transition to the lower level of postwar production in an orderly fashion.

POSTWAR DEMAND

The relative magnitude of the adjustment that will be required in crude oil output following V-J Day is rather clearly indicated, although the exact level of demand will depend in part upon the interval between the end of the European war and the Pacific war, the speed with which reconversion to peacetime production is carried forward, the policy that may be pursued with regard to meeting military demands for oil out of accumulated stocks after the war, and similar factors. At best, the conclusion is inescapable that the petroleum industry will experience a sharp decline in demand sometime during the first twelve months after V-J Day. This is readily apparent from a brief consideration of the probable changes in military and civilian demands.

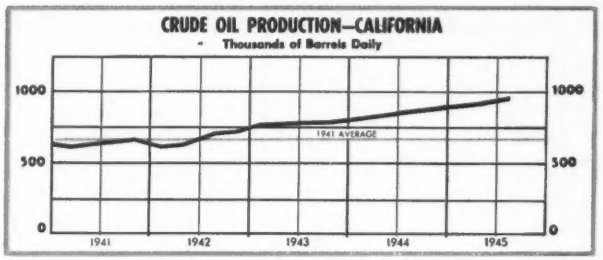
The reported military requirements of 1,600,000 barrels daily of petroleum represent an expansion of several times the amounts consumed by the armed forces of the United States in 1939. It would be extremely difficult for anyone to estimate the actual military consumption of refined products in the first year after the defeat of Japan. That will depend on the military forces that may be maintained abroad, the rate of demobilization, and other factors undetermined at this time. At the end of the war, military stocks of aviation gasoline, and perhaps of some other products, both in the United States and in foreign theatres, will be large in relation to immediate demands. Therefore, the armed forces will not need to purchase as much oil as they consume for a period following V-J Day. Within the year after the end of the war,



purchases for actual military use may well decline by 60 per cent or more from the present level.

Civilian demands will increase whenever it is possible to remove the remaining restrictions on consumption. Such demands probably will not return immediately to the level of 1941. Industrial consumption of fuel oil and other products will decline as production does, and during the twelve-month period after V-J Day it may be less than the demand in 1941, depending upon the extent of reconversion from coal back to fuel oil. The demand for heating oil for homes will increase, but not in large amount. The principal handicap to other civilian consumption will be the smaller number of passenger cars and the higher average age of these vehicles. Passenger car registrations in the United States in 1944 were about 25,000,000, or nearly 4,000,000 less than in 1941. The average car in 1941 consumed more than 16 barrels of gasoline. The decline in registrations represents the loss of a market that might amount to 175,000 barrels daily. Furthermore, the cars in use now are much older and not driven so much because of their less satisfactory mechanical condition, so that their annual consumption will be lower than in 1941. In view of all these circumstances, non-military demands for petroleum products cannot be expected to increase by more than a few hundred thousand barrels daily in the first twelve months after V-J Day. This may well fall short nearly 1,000,000 barrels daily of balancing the maximum decline that will take place in military demand.

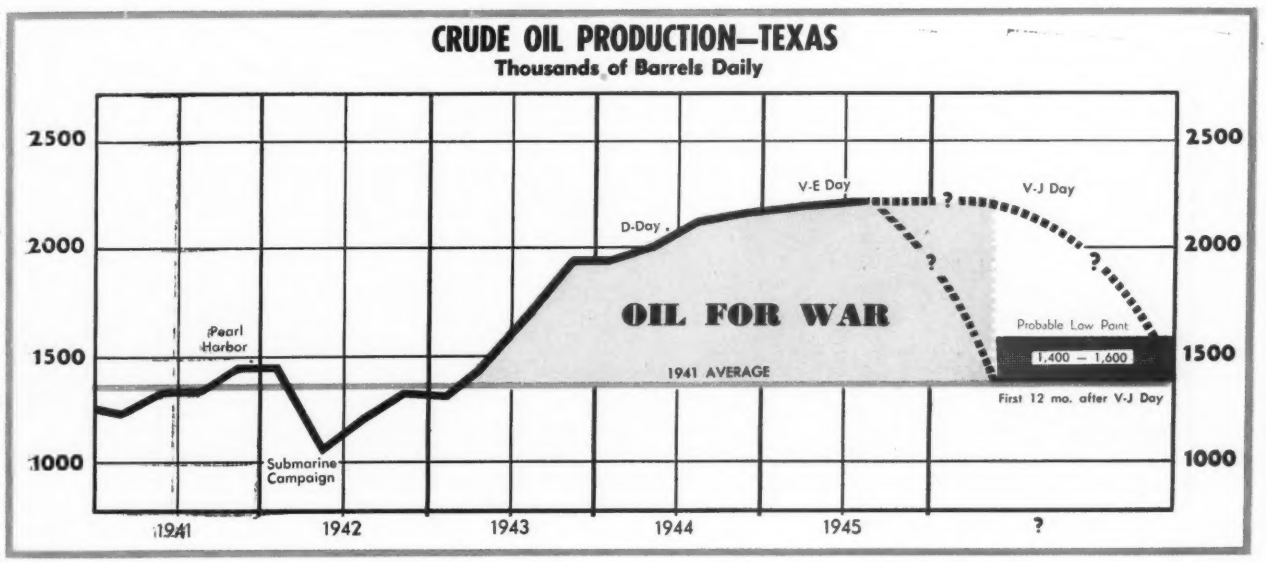
Domestic demand will be the primary determinant of crude oil production, but the relation of exports and imports will also have some influence. In 1941, exports of petroleum from the United States exceeded imports by only 35,000 barrels daily. Since 1941, there has been an expansion in foreign crude oil production in the order of magnitude of 500,000 barrels daily, or more. The existence of this additional capacity and the pressure of great foreign reserves on the market will make it difficult for this country to maintain any sizable export balance of petroleum. Exports should not be counted upon to cushion the shock of the postwar drop in domestic and military demands, since they will decline as soon as the regular flow of oil in world trade can be resumed.



Another factor that may influence crude oil production is the accumulation of crude oil stocks. Some additions to stocks may be justified or required because of withdrawals that have occurred during the war. In the past four years, withdrawals of crude oil and refined products have amounted to about 66,000,000 barrels in California and 34,000,000 barrels in the rest of the United States. These areas are relatively self-contained in normal times with regard to petroleum, because of the high cost of transportation between them, so that stocks must be considered separately for the two areas. The additions required to replace half of the withdrawals since 1941 outside of California would average 50,000 barrels daily for a year, or only about 1.5 per cent of the estimated production for the area. As demand decreases and refinery runs of crude decline correspondingly, there will be less need to rebuild stocks. Postwar production therefore, must be closely related to demand. The major adjustments following V-J Day will be complicated and prolonged further if stock accumulations are too rapid or too large.

CONCLUSION

It is not clear at this time how much longer Japan will choose to carry on her futile fight. It is the fervent hope of our nation that the Pacific war may end soon in order to reduce the casualties and the destruction of further conflict. If the war should end suddenly, however, the difficulties of



the postwar period may be magnified. It is essential, therefore, that preparations be made promptly by all industry to meet the impact of the postwar period.

The probable decline that will occur in crude oil production for the United States and Texas is evident from the charts by comparing the anticipated low point in the first twelve months after V-J Day with the present production. It will be noted that the decline may reach at the low point about 20 per cent for the United States and more than 30 per cent for Texas. Texas must be prepared for an adjustment greater than the average of the nation as a whole, since it has contributed such a large share of the oil for war. While it is not clear just when the major decline will occur, it will probably be within three to nine months after V-J Day. It is essential that the military authorities and Government agencies having influence over its operations keep in mind the prospect for the postwar period and do all they can to keep the industry informed of probable changes in demand and to facilitate the adjustment.

Crude oil producers will face troublesome times within the first twelve months after V-J Day. The abnormal war demands will disappear and market outlets will shrink rapidly. As production declines, the cost per barrel will increase, particularly in Texas and California, because of the lower output per well. The existence of productive capacity substantially higher than demand will create difficult problems and act as a depressing influence on prices. Prompt adjustments must be made to demand as it declines after V-J Day, in order to avoid the over-supply of petroleum that will lead to waste. The nation cannot afford to permit the development of chaotic conditions in the petroleum industry, which would seriously impair its contribution to full employment and its ability to discover and develop new reserves to meet future demands.

The wisdom of regulating production to market demand in order to avoid waste has been clearly demonstrated during the past fifteen years. Without such regulations, the industry never could have supplied the additional amounts of oil required for military purposes in the last four years. The national interest requires, therefore, that the difficult problems of the transition period be met by the industry and the state conservation agencies in such manner as to maintain a vigorous petroleum industry.

State conservation agencies have gained much experience since the days of the East Texas Field in regulating supply to meet demand. They have developed principles for the conservation of oil and for the equitable allocation of production between fields and properties. The principles and administrative techniques for preventing waste of oil are well developed and can be applied by each producing state. Every producing state must share the responsibility for meeting the postwar adjustment. The Interstate Oil Compact Commission has a role to play by encouraging the cooperative action among the states that will be necessary to the proper solution of production problems. The industry must be alert to the problem, and can facilitate the adjustment by prompt presentation of facts to the state agencies and Interstate Oil Compact and by lending its support to their efforts. Each producer has his share of responsibility in the necessary adjustments.

The problems that will arise after V-J Day will be difficult but not insurmountable. It must be borne in mind that they are an aftermath of war conditions and are as abnormal as the excessive production rates of the past two years. They can be met best by a vigorous, competitive industry that is not handicapped by the continuation of wartime controls. The same ability, ingenuity, and cooperative understanding that enabled the industry to perform great service during the war should prepare it to deal promptly and effectively with the problems after final victory.

FULL OF POWERFUL AVIATION GASOLINE, NAVY PLANES AWAIT ANOTHER SORTIE AGAINST JAPANESE-HELD ISLANDS

THIS ACCUMULATION OF LOGS IS AN EXAMPLE OF THE OUTPUT OF A SECOND GROWTH FOREST IN ANGELINA COUNTY, TEXAS

Timber *FOR TOMORROW*

Petroleum plays vital role in modern logging, reforestation, and fire prevention methods in timberlands of Texas

SCIENTIFIC management of Texas timberlands can mean continuing economic prosperity for the people of the lumbering sections of the state, according to state and industrial foresters. Through good forestry practices, some Texas timber owners have already logged the same tracts from two to six times in the past 45 years without injuring the growth capacity of their forests.

State forests have played an important role in supplying our fighting men with the tools and equipment of war, for wood is one of the great strategic materials of modern war. For every man and woman in the armed services, 2,000 board feet of lumber is needed. The demand for pulpwood for paper and chemical uses is equally high.

Even in peacetime wood is a valuable and versatile material. It is particularly important to the United States, which normally uses nearly half the lumber, more than half the paper, and two-fifths of the wood in all forms used in the world.

That our output of wood did not fall hopelessly behind the huge quotas set up by our tremendous war drive is a tribute to the men and women of the forest industries, and to the workers of the allied industries whose help is vital in getting the trees out of the woods and onto the firing line.

The petroleum industry plays an essential role in the task of supplying forest products to the fighting men. Felling a tree in the heart of a great forest is of no useful value if the tree cannot be brought to the sawmill or paper mill or if the lumber or pulp made at the mill cannot be shipped where needed. In this job, the railroad and trucking facilities of the nation have performed nobly, and behind them the

petroleum industry has lived up to its reputation as prime mover of our war machine, both at home and abroad.

The work of these united industries is especially noteworthy in the forests of Texas, and throughout the South, where the bulk of the production is obtained from second growth forests, grown under modern techniques on land previously cut-over. Logging methods here vary considerably from those used in the great virgin forests of the Pacific Northwest, but improved mechanization enables Texas timber owners to meet war demands without injuring their forests.

Texas forests produced in 1943, the last year for which complete figures are available, in addition to lumber, 399,000 cords of pulpwood, 45,000,000 board feet of veneer logs for baskets and crates, 1,777,000 cords of fuel wood, 430,000 poles and piling, 9,419,000 fence posts, 3,756,000 cross ties, and 23,000 cords of wood for cooperage and other uses. These valuable products, harvested from second growth forests, are convincing proof that Texas timber, wisely handled, is indeed a crop.

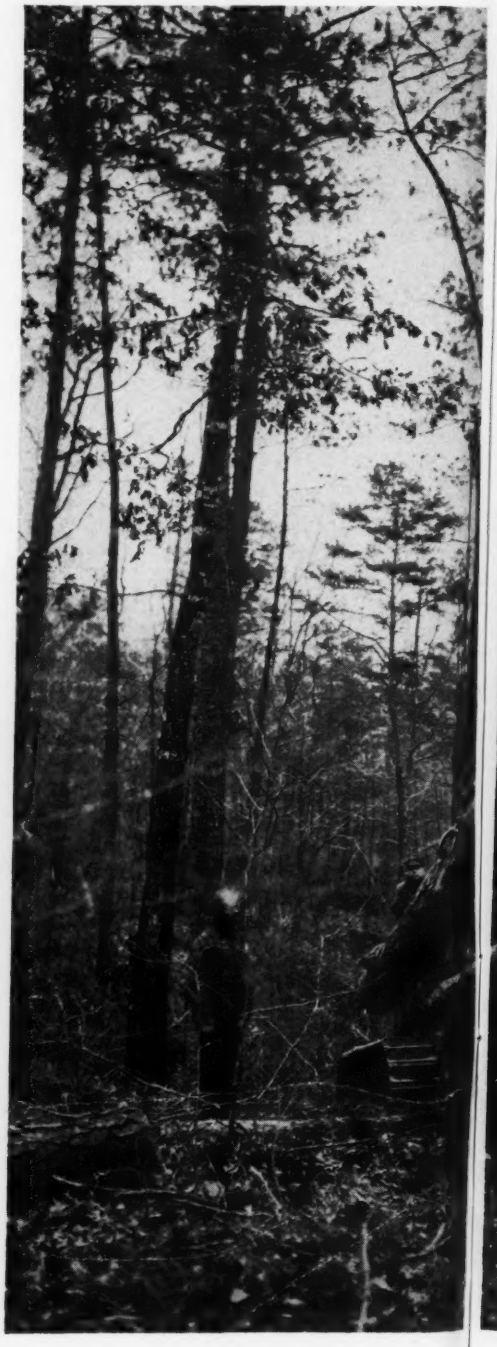
Uses of oil and petroleum products in Texas forests are almost endless. From the "faller," who wields the axe and the crosscut saw—which, incidentally, must be frequently lubricated with kerosene so it will not stick—to the tractor operator whose "cat" snakes logs out to the woods road, virtually all logging workers make regular use of petroleum products in one form or another.

As in so many other fields, mechanization has had a pronounced effect on methods of operation in the logging industry. Many mills are Diesel-operated. Power-driven saws have taken over much of the heavy work of felling and bucking, which means sawing a felled tree into logs. The picturesque teams of work horses and oxen of years ago have given way to the faster and more efficient motorized equipment that ceaselessly rumbles and roars over the forest floor and along forest trails and roads.

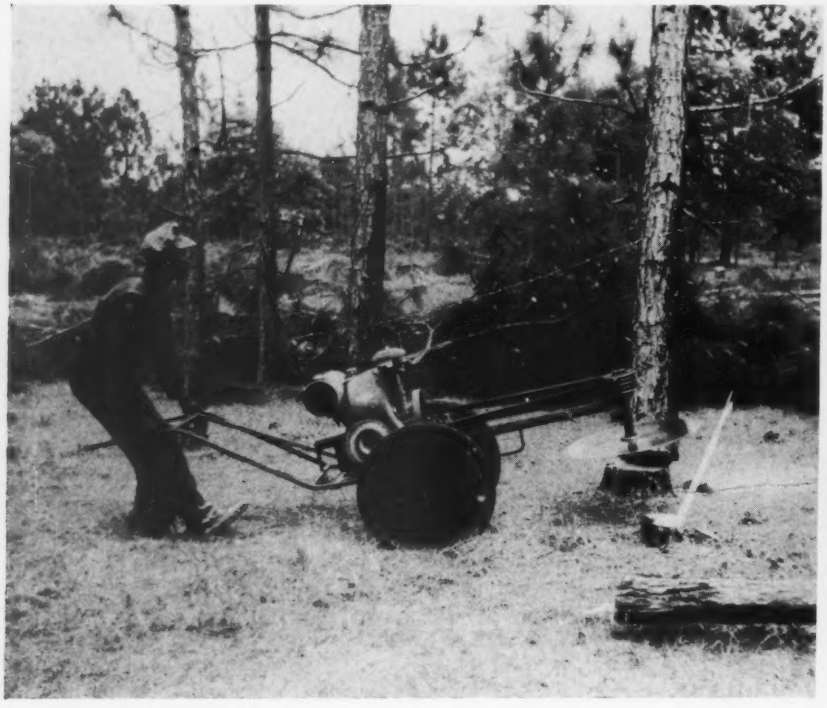
The spread of truck logging has proved invaluable in preventing and fighting forest fires.

Modern forest fire suppression systems have as their basis the speedy dispatching of trucks and equipment to combat fires while they are still small. Widespread networks of woods roads and fire trails interlace many Texas forests. Along these oiled, well-kept roads, fleets of fire-apparatus trucks race to the scenes of fires reported by lookouts in their lonely towers.

Texas has additional fire lookout protection during periods of high fire hazard, through its trail-blazing air patrol of the forests. During fire weather, planes of the Civil Air Patrol, in cooperation with the Texas Forest Service, fly patrols over 9,000,000 acres of timberland in 31 east Texas counties. By two-way radio communication, or by a system of signals, the planes can direct fire trucks—and even volunteer workers

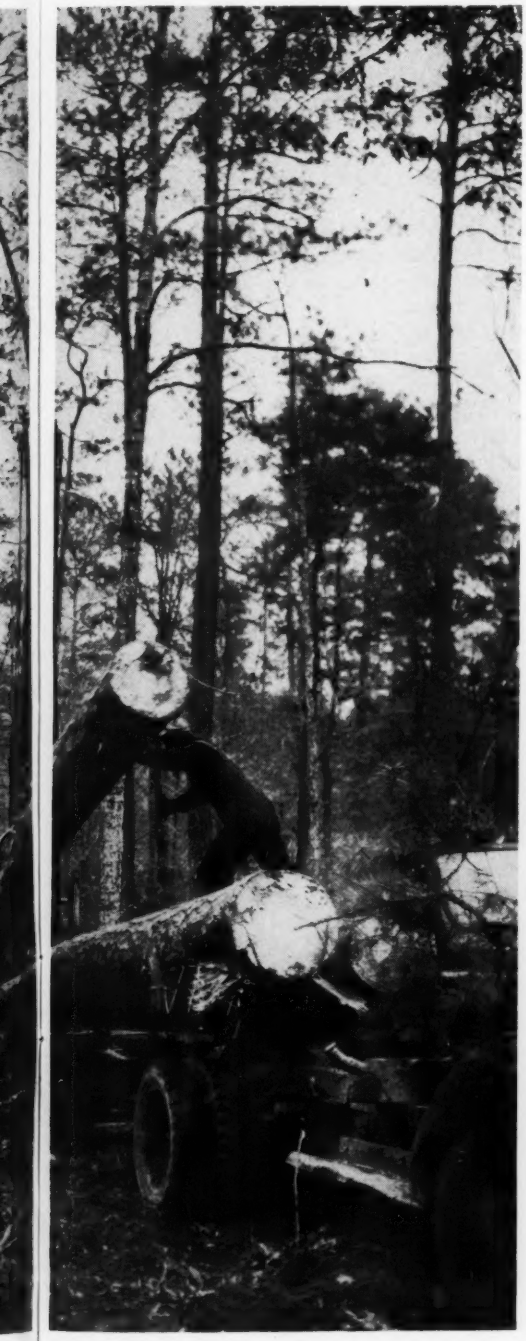


CUTTING TREES with new gasoline-powered horizontal saw aids the industry during wartime labor shortage. Center, Southern forests are increasingly logged with aid of oil-powered equipment.



—to the scene of a blaze without loss of time.

In addition to fire prevention efforts, the forest industries are engaged in a constantly widening attempt to develop new uses for the products of the woods. The axe and the saw, which have written most of the history of wood, have gained new allies in the retorts and test tubes of science. Wood has built our homes, and has furnished them. Now it also serves as a raw material for paper, plastics, textiles and many other materials, some far removed in appearance from the original tree. Plywood flies the airways and cuts through the seas. Compressed woods take over the work of metals; pliable woods hint at unsuspected new uses.



In 1900, only about a third of the wood in a harvested tree could be used for lumber. Today, processes exist which permit using almost all the wood in a tree. The future of wood seems greater than its past—a challenge to the logger, millman, paper manufacturer, chemist and physicist, as well as to the merchandiser and economist.

To protect that future, Texas forest operators endeavor to assure continuous crops of timber by keeping fire out of the woods and by harvesting timber stands in such a way as to encourage new growth to come in on the cut-over areas. Much Texas timber is logged under selective harvesting methods, which do not strip the forests bare, but harvest only part of the timber in any area. With increased sunlight and soil nourishment available to the trees left standing, they immediately increase their rate of growth. More important, perhaps, seeds scattered by the mature trees take root in the spaces left by the harvested tree, and the forest floor is soon covered with young growth.

So effective is this natural regeneration that it is not considered necessary to hand-plant new trees in Southern forests, except in areas that have been swept by repeated fires. When the natural fertility and ground cover of the land have been destroyed by uncontrolled fires, planting may be required, but nature spreads seeds with so liberal a hand from the parent trees left by modern loggers that planting is the exception, rather than the rule.

Generally, the forest industries program of leaving seed trees, protecting mature timber and new growth from fire, and planting seedlings in burned out areas, indicates continued crops from the forests in the years ahead.

In 1939, a relatively normal year, the manufactured value of forest products in Texas exceeded $52,000,000, not including Texas wood used by several out-of-state pulp mills. In 1942, the state's lumber industry alone had an average monthly employment of 27,082 workers.

Already a substantial factor in Texas' economy, the forest industries may be expected to bulk larger as the spread of good forest management furnishes increased crops. In those future harvests, petroleum products will play an ever greater part than they now do—and their role is already a large one.

USING THIS chain saw, a four-man crew fells and bucks about 36 cords of wood a day. Without such mechanization manpower shortage would be even more of a problem in the forests than it is.

SIGHTING FROM THRIBBLE-BOARD TO ORIENT THE DRILL

TARGET Below

THE HISTORIC DIRECTIONAL WELL AT CONROE WHICH KILLED THE OIL FLOW FROM THE WILD WELL ON THE RIGHT

THE telegram that John Eastman held read:

H. JOHN EASTMAN, NOVEMBER 13, 1933
LONG BEACH, CALIFORNIA.

DRILLING OPERATIONS HAVE BEGUN ON CONROE WELL STOP WILL BE READY TO DRILL PLUG ON NOVEMBER 19 STOP WOULD SUGGEST YOUR MAKING PLANS ACCORDINGLY.

JOHN R. SUMAN.

To his waiting secretary, John Eastman dictated this reply:

JOHN R. SUMAN,
HUMBLE OIL & REFINING COMPANY,
HOUSTON, TEXAS.

SHIPPING EQUIPMENT TODAY. WILL BE THERE WITH CREW READY TO START SERVICE ON 20TH.

H. JOHN EASTMAN.

And thus were placed in motion the mechanics for one of the most dramatic experiments in the history of oil well drilling. One that focused the attention of oil men the world over on a 15-acre tract in the center of the Conroe Field. An experiment that proved man could plot the course he wished a drilling bit to follow and keep the bit on that course until it hit the target more than a mile below the surface.

Although controlled directional drilling to kill a wild well was a distinct innovation at the time of the Conroe crater, directional drilling of oil wells had been practiced for some years in California. During the development of the Huntington Beach Field in 1926, it became apparent that a great portion of the oil-bearing structure lay under the Pacific Ocean. Two wells completed in 1930 mysteriously produced more oil than other wells in the field, and it was surmised

that these wells had been deviated from the vertical to tap the oil under the ocean. When the secret of the two mystery wells was revealed in 1932, an extensive directional drilling program at Huntington Beach was inaugurated, which resulted in the completion of 90 wells under the ocean.

Because of the success of the Huntington Beach directional drilling program and the subsequent use of this method in drilling wells at Santa Fe Springs, Elwood, and Mt. Poso, Humble's production engineers were convinced that a directionally controlled hole could be drilled to intersect the bottom of the Conroe cratered well.

On November 13, 1933, the date of the historic telegram from Mr. Suman, drilling was started on Humble Oil & Refining Company's O. L. Alexander H-1, located 412 feet northeast of the crater. On November 26, John Eastman took over the supervision of the directional drilling, and on November 29, ran a knuckle joint in the well to deflect the hole in the desired direction. On January 6, 1934, the final directional surveys showed the well was completed in oil sand at 5,135 feet, twenty feet from the vertical center line of the cratered well. Water pumped through H-1 finally killed the wild well.

"The greatest struggle between science and nature in the history of the oil business," said a newspaper. "One of the most interesting petroleum engineering feats ever undertaken in this country," a magazine stated. "A brilliant theory and a brilliantly executed plan," was the verdict of oil men; and because of the confidence of Humble engineeers in the soundness of the theory on which directional drilling is based and their willingness to stake a great amount of money and effort on their convictions, a new drilling method was proved.

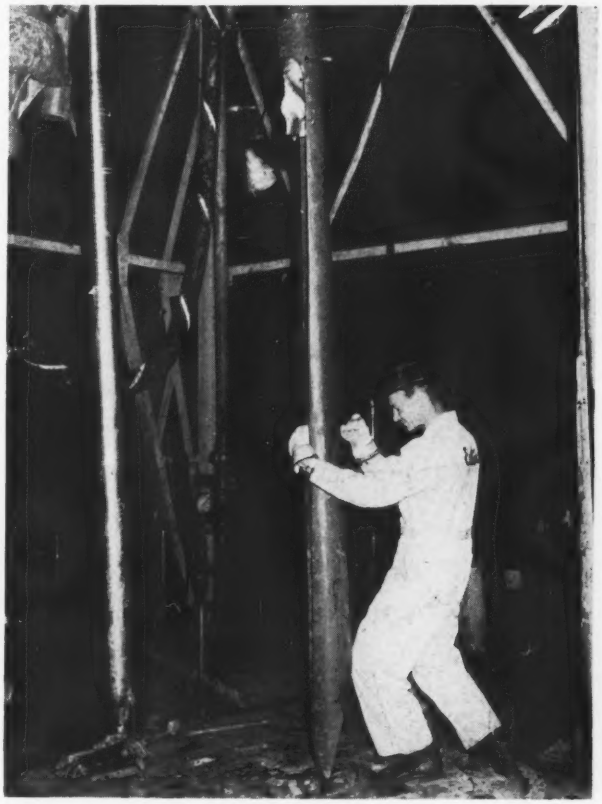
Controlled directional drilling became possible only after efficient and accurate well surveying methods had been perfected. In the early days of the oil industry, when the principal object was to get there first with the most wells, little attention was paid by producers to the relative straightness of the holes which they drilled. As far back as the 1870's, however, mining engineers, especially those in the diamond mines of South Africa, had recognized the tendency of bore holes to drift away from the vertical. By 1907, a photographic-recording instrument was used in surveying bore holes to a depth of as much as 4,000 feet.

It was not until 1924, however, that oil well surveys became established in the United States. Geologists were aware that sub-surface contour maps platted from information derived from well logs were oft-times extremely irregular. This led them to assume rightly that the vertical depth as indicated on the well log was not actually the true vertical depth, which would indicate that the well had been drilled at an angle. These assumptions were substantiated by such classic examples as two wells in California, which were located 2,000 feet apart at the surface and yet ran together at 6,000 feet below the surface; and the two wells in the Seminole Field, which were started 660 feet apart and intersected at 1,900 feet.

After Alexander Anderson's startling disclosure in 1928 that the average horizontal deviation of 104 five-thousand-foot wells was over 500 feet, operators began to realize that a straight well was the exception and not the rule and began to understand the underlying cause for some of the strange happenings and unusual difficulties which often plagued them.

Well surveying, since 1928, has become standard practice by most operators. As drilling progresses, surveys are made at regular intervals and from these surveys the operator can compute the angular condition and position of the hole. This

SETTING THE TIMING MECHANISM FOR A WELL SURVEY



SIGHTING THE WHIPSTOCK BEFORE LOWERING INTO HOLE

ORIENTING A KNUCKLE JOINT, ANOTHER DEFLECTING TOOL

assists him in maintaining a straight hole and provides the information from which corrective measures may be planned and executed with the least expenditure of time and money.

Such surveys are ordinarily conducted with a single-shot surveying instrument. This instrument consists of a free-hanging pendulum or plumb-bob, with cross hairs and a free-floating, transparent magnetic compass. The instrument is lowered into the hole and after a certain length of time, which is controlled by a timing device, a photographic record is made of the location of the plumb-bob cross hairs with reference to the transparent compass disk. In this manner the inclination from the vertical, as indicated by the plumb-bob, and the deviation from true course, as indicated by the compass, are recorded simultaneously.

When the well has been drilled to bottom or when controlled deviation is to be attempted, and as a check against the results of the single-shot survey, a multi-shot survey of the hole is made. Such a survey produces a continuous record of inclination and direction from which the course of the well may be plotted and the terminus located.

Multi-shot instruments utilize a magnetic compass or gyroscopic indicator to record the direction of the well, and plumb-bob, pendulum, or level to record the inclination from the vertical. The direction and inclination are simultaneously recorded photographically at regular intervals.

Because of the probable effect of well-casing on the magnetic compass, multi-shot surveys of cased-wells are quite often conducted by combining a magnetic survey of the uncased portion of the hole with an oriented drill pipe survey of the cased portion. Orientation of drill pipes consists of measuring the angle, if any, through which each section of drill pipe turns as it is lowered into the hole. This angle is measured by mounting a clamp on the upper end of the section of pipe and on that clamp a telescope which is sighted on a distant fixed reference point. The telescope is removed and the clamp left in place as the pipe is lowered into the hole until the clamp is about 4 feet above the derrick floor. There a surveying transit is attached to the clamp, is sighted on the reference point, and the angle of turn read.

Assuming that the deviation of the bottom of the drill pipe is reflected in its surface deviation, it is possible, by orienting the drill pipe, to know at any time the direction in which the bit is pointed. This information, plus the known inclination from the vertical as indicated by the plumb-bob, is the foundation on which the practical application of directional drilling is based.

Directional drilling means drilling a hole to a designated objective. This may mean maintaining a vertical hole which bottoms directly under the derrick location. Or, it may mean drilling a well which reaches an objective two thousand feet away and 6,000 feet below the derrick.

Accomplishing either of these objectives depends upon accurate well surveys, a thorough knowledge of drilling techniques, and the use of special deflection tools.

Special deflection tools cause the drilling bit to be side-tracked from its original course and follow a new course which has been planned in advance. Typical of such tools are the knuckle joint and the removable whip-stock. The removable whip-stock is a tapered, wedge-shaped casting about 10 feet in length. It has a chiseled point which prevents turning after the whip-stock has been set in place, and a tapered channel through which the drilling bit is guided away from its normal course. A flexible drill collar assembly is used which allows the bit to be deflected easily into the side of the hole away from the whip-stock. After drilling about 20 feet at the new angle, the bit is pulled back and engages the ring at the top of the whip-stock; then the bit and whip-stock are pulled out and the new hole reamed to full size.

A knuckle joint is a combination drilling and reaming assembly at the top of which is a universal joint which is attached to the drill pipe by means of a spring. The drilling bit is held at an angle of about 4½ degrees to the drill pipe, while the universal joint allows the drill to turn and still maintain its angle as the drill pipe is rotated. As in the case of the whip-stock, about 20 feet of directional hole is drilled with the knuckle joint and it is then removed and the hole reamed to full size after which regular drilling proceeds.

From these descriptions of deflection tools, two things are apparent. First, only small angular deflections can be accomplished with each setting of the whip-stock or each use of the knuckle joint. Second, unless the setting of the whip-stock or of the knuckle joint can be accurately and positively determined, no control of the direction of the hole can be maintained. Thus, the complete dependence of controlled directional drilling upon accurate well surveying is demonstrated.

After the new direction has been established by use of the whip-stock or knuckle joint, drilling is maintained along this course by techniques perfected through years of experience. Drillers have found that at ordinary to slow speeds, with ordinary excess weight on the bit, the hole has a tendency to drift in a clockwise direction. Under the same conditions, but at *fast* speeds, the hole reverses itself and begins to drift in a *counter clockwise* direction.

When it is desired to *maintain* the slope produced by the knuckle joint or whipstock, the driller uses a stiff drill collar

assembly above the bit and applies only ordinary weight to the bit. To *increase* the slope, he will use a limber drill collar assembly and add excessive weight, which will cause the drill pipe to bend. When a *straight* hole is required, he takes full benefit of the plumb-bob effect of the drill stem and bit and uses a stiff drill collar with light weight.

By controlling the direction of the bit according to the drilling techniques previously explained, and by maintaining close check on the inclination and direction of the hole through the use of single-shot surveys, the driller can guide the bit to his objective.

An example of the effectiveness of such methods is illustrated by Vanderbilt State 11 drilled by Humble Oil & Refining Company in the West Ranch Field. From a shore location approximately 1,750 feet away from the objective under the waters of Menefee Lake No. 1, a hole that at times had a slope of 30 degrees was drilled.

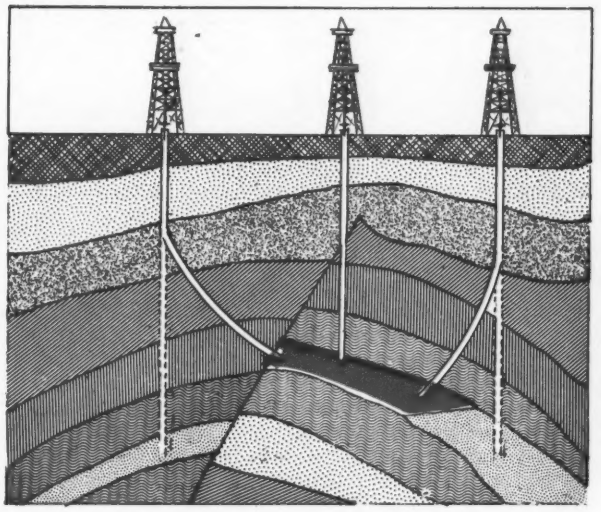
Shore-side drilling to objectives beneath water is one of the outstanding uses for which directional drilling is currently employed. The Huntington Beach wells under the Pacific Ocean are, of course, classic examples, and similar wells have been drilled in many parts of the world. Directional wells were drilled beneath the China Sea, while in Argentina a number of wells were directionally drilled to locations under the Gulf of San Jorge. Under the Irrawaddy River in Burma, wells were directionally drilled from the shore because drilling foundations would have interfered with the navigability of the stream. A similar condition applies to wells drilled by Humble Oil & Refining Company at Darrow and Potash, Louisiana, under the Mississippi River, or to wells under the Brazos River at Raccoon Bend. In all instances, either because of the economy of shore locations, or the impossibility or impracticability of water locations, the derricks have been set up on dry land and the wells have been directed unerringly to the oil lying beneath the water.

The effectiveness of directional drilling for contacting oil sands beneath man-made obstructions has been graphically illustrated by those wells which terminate under the Capitol at Oklahoma City and under the cemeteries in Long Beach, California. In the Hastings Field, Humble drilled a directional well under a highly-prized fig orchard.

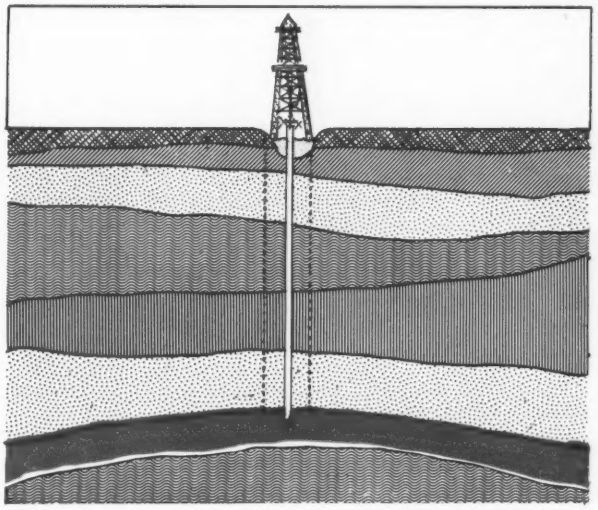
Of late, more attention has been given to the use of directionally drilled wells to overcome difficulties caused by topographical conditions. Where mountains, ravines, bogs, and the like are encountered on the surface above spots which are geologically favorable potential oil producing locations, it is quite often possible to offset a few hundred feet and find better surface conditions from which a directionally controlled well can be drilled to the sub-surface objective.

One of the most widely used applications of directional drilling is that involved in bottoming a hole within certain narrow limits beneath the derrick. Outstanding examples of this controlled vertical drilling are Humble's Menefee Bayou State B-1 and 2 in the West Ranch Field. As the name implies, these two locations are on a small bayou which is state property and drilling agreements require that they be bottomed in the area between the leaselines on either side of the bayou. Since this distance was only some 20 feet, and the depth to be drilled was over 5,000 feet, it is apparent that full utilization of directional control was required to conform to these narrow restrictions.

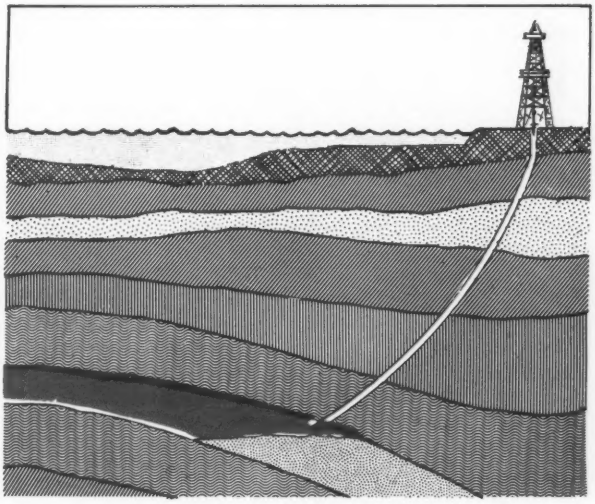
In the Gulf Coast, land of salt domes, directional drilling has been of material assistance in completing wells around the flanks of such domes. Wells which inadvertently drill into



DIRECTIONAL DRILLING OF WELLS INTO PRODUCTIVE AREAS



DIRECTIONAL HOLE TO BOTTOM WITHIN A NARROW LEASE



DIRECTIONAL DRILLING TO REACH OIL SANDS UNDER WATER

the salt can be directionally controlled to angle out of the salt and tap the oil reservoirs along the flanks of the dome. Other wells can be so located that, although they drill beyond the overhang often found in such domes, the hole can be directed to a point below the overhang, to contact the oil.

Edge wells, which are valuable in defining the limits of a productive field, often can be made into producers by deflection back toward the area proved to be productive. In working over old properties, old well holes can quite often be utilized as a beginning from which controlled holes can be directed towards known producing horizons or newly discovered sands. This is an adaptation of the widely used method by which unproductive wells located beyond a fault zone are directionally controlled to drill through the fault and into the productive sand. Fully 10 per cent of directional drilling work in the Gulf Coast area is concerned with crossing faults.

The most spectacular, but happily the least frequent adaptation of directional control is in the drilling of relief holes to kill wild, burning, or cratered wells. Just as in the famous Conroe crater, the drama of the situation draws the attention of oilman and layman alike. Such a case was that of Humble State D-6, the wild well of Laguna Madre.

Humble's State D-6 was a 10,000-foot test located about a thousand yards offshore in the shallow waters of Laguna Madre. Equipped with the finest drilling rig obtainable and the most modern of blow-out prevention equipment, State D-6 was ready for almost any eventuality. The well was spudded in November 30, 1940, and on February 16, 1941, while coring in a sand below 8,500 feet, began showing gas at an abnormally high pressure.

While an attempt was being made to control this high pressure with a heavily weighted drilling mud, drill pipe stuck at about 3,100 feet and had to be cut loose. Before the drillers had an opportunity to attempt to retrieve the stuck pipe, gas pressure again began mounting rapidly until it reached 2,400 pounds per square inch. Attempts to relieve the gas pressure or to seal off the gas-producing formation were in vain, and finally, at 2:40 p.m., on February 24, State D-6 caught fire and burned out of control.

Immediately, a levee was constructed around the burning well to isolate it from the bay water, and over 350 tons of iron and concrete were piled into the crater to break up the column of salt water which geysered into the air.

Plans were made without delay for the drilling of State D-7 as an offset relief well through which D-6 could be controlled. D-7 started drilling on March 11, fifteen days after D-6 went wild.

Fortunately, D-6 had been directionally controlled to be as nearly vertical as possible, and because of this, the location of the bottom of D-6 could be calculated as resting somewhere within a circle 126 feet in diameter. This was the target toward which D-7 was aimed.

For the first 3,700 feet, D-7 was drilled vertically, and then three removable whip-stock settings were made, increasing each time the deviation from the vertical. Using the controlled drilling technique involving weight, speed of rotation and relative rigidity of drilling assembly, the drillers sought to keep the bit on the predetermined course. A number of times they had to stop, back up, and begin again—in all, 19 whip-stock settings were used in directing the hole to a point which surveys on July 12 showed to be within 44 feet of the calculated bottom of D-6.

D-6 was killed, and although that happened more than four years ago, the accomplishment still makes talk where oil men gather. And it is upon such accomplishment as this, and the day-to-day application of directional drilling by which many additional barrels of precious petroleum have been made available to America in its hour of need, that drillers base their statement: "Show us where; give us the chance; and we'll hit the target below."

HUMBLE'S DIRECTIONALLY DRILLED STATE D-7 IN LAGUNA MADRE WAS AIMED AT THE CRATER OF WILD D-6 IN UPPER RIGHT

CUTTING FLUIDS WITH HIGH LOAD-CARRYING CHARACTERISTICS ALLOW MORE ACCURATE MACHINING OF TOUGH STEELS

Attractive Precision

New Humble Cutting Fluids have helped establish unusual standards of precision and cleanliness in Texas war plant shops.

AN OLD-TIME machinist accustomed to the dark, grimy, and oil-spattered surroundings of early machine shops, would be amazed if he were to step into some of Texas' great new war plants.

The engineers who designed these war plants refused to accept the established idea that machine shops are necessarily bleak and unattractive places. Instead, the modern shop is light, airy, and immaculately clean. High-speed lathes grinders, shapers, and drills are painted in gay light colors which are not only pleasing to the eye but actually add to the efficiency of the operator.

And the operators, instead of the grimy machinists of days gone by, are clean and neat, and many of them are young, attractive girls dressed sensibly but colorfully. Under their skilled touch the machines turn out literally mountains of precision parts, accurate to the thousandth of an inch.

These new standards of precision, and certainly, these new conceptions of machine shop cleanliness, could not have been possible without the development of modern cutting fluids. The tough alloy steels used in the manufacture of machines of war and the high speeds at which these parts are produced made necessary cutting fluids with unusually high load-carrying capacities. The precision required in these microscopically-perfect parts demanded a fluid which would impart a fine finish to the work piece and preferably one that was transparent, allowing continuous inspection of the work. The new standards of cleanliness indicated that such a cutting fluid would be non-staining and light in color.

With these requirements as a yard stick, Humble laboratories have developed a group of new cutting fluids which have played an important part in the record production accomplishments of Texas war plants. These cutting

fluids are transparent, golden-colored oils graduated in consistency and load-carrying ability to meet the various needs of diversified machining operations. They perform capably the two principal functions of a cutting fluid: cooling and lubricating.

In any machining operation, metal is removed from the work piece by gouging, trimming, prying, or grinding. In all instances, friction occurs between the work piece and the tool. This friction generates heat and is added to the heat created by the movement of the chip along the tool. The cutting fluid must dissipate this heat to prevent distortion of the work piece and dulling of the cutting tool.

The lubricating, or load-carrying qualities of a cutting fluid are made necessary by the mechanics involved in the action of cutting. As the work piece is spun at high speed, the cutting tool is pressed against it and serves as a wedge to pry away the excess metal. The metal is actually ruptured ahead of the cutting edge of the tool and the chip that is formed slides along the face of the tool and curls up and breaks away.

The lubricating film provided by the cutting fluid eases the motion of the chip along the tool face and prevents the development of excessive frictional heat between the chip and the tool.

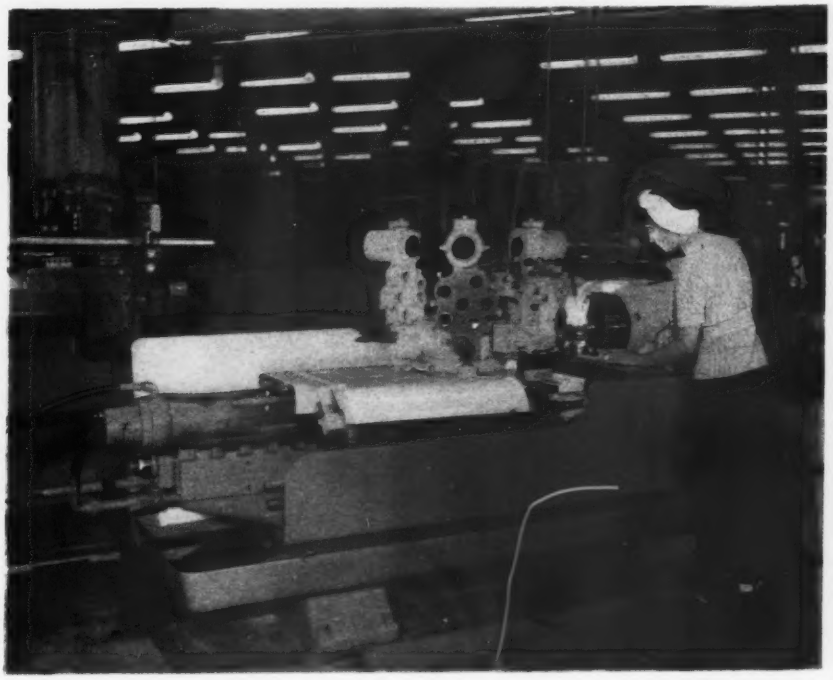
Early cutting fluids used a fatty oil such as lard-oil to provide lubrication. When petroleum became generally available, mineral oils were added to the fatty oils to lower the cost of the fluid and to offset the tendency of fatty oils to turn rancid.

As the use of tough alloy steels became more general, the load-carrying requirements of cutting fluids increased. To solve this problem, sulfur was added to the fatty oil-mineral oil blend.

The newest development, as typified by one group of Humble Cutting Fluids, is the addition of chlorine to increase the load-carrying properties of the cutting fluid. The action of sulfur and chlorine in providing a lubricating film takes place at temperatures of from 300 to 400 degrees Fahrenheit. In high-speed work on tough steels, such temperatures are not uncommon and would cause a straight mineral oil to disintegrate. However, at temperatures above 300 degrees, the sulfur and the chlorine form ferric sulfide and ferric chloride which act as metallic film lubricants between the tool and the metal work piece.

These new Humble Cutting Fluids make their contribution to production for war by speeding up machining operations, increasing tool life, and assisting in gaining the precise measurements so absolutely necessary. All this they do cleanly and neatly, proving that attractive precision is an established fact in modern machine shops.

TURRET LATHE, finishing to microscopic accuracy a part for the great new B-32 bomber, works through a transparent flood of Humble cutting fluid. The fluid acts as a combination lubricant and coolant. (Below) An automatic chucking machine in Consolidated-Vultee Aircraft Corporation's Fort Worth plant illustrates the immaculate attractiveness of modern machine shops.



IN ACTION on a high-speed engine lathe, a new Humble cutting fluid is transparent, allowing a clear view of work; it is non-staining, encouraging new standards of cleanliness for the operator and shop; it withstands the friction developed, making for greater precision.

THE CARPENTERS BESIDE THEIR 100,000-MILE TRAILER

AND THEY LIVE *Happily*

Humble Annuitants . . . what they think of the Companies' annuity program and how they live

LIFE as an annuitant is pleasant, especially if in the waning years of active work with the Humble Company preparation is made for retirement.

The Humble Companies' Annuity Program is a wonderful one and every employee should study and understand it thoroughly and should participate fully in all of its benefits.

These two statements contain a summation of thoughts expressed by Humble annuitants ranging in age from 60 to 80—men and women who speak with the voice of experience and in whose voices is evident the ring of satisfaction so common to people who find in the autumn of life a full measure of contentment and happiness.

Convinced that young men and women everywhere in the Humble Companies would be interested and would find food for thought in the words of wisdom which retired Humble people might be willing to pass along, THE HUMBLE WAY recently set about to find out and compile some of the opinions of annuitants and to see first hand how these elderly folks live and what they do in their years of deserved rest.

Before beginning the series of interviews, Annuity & Benefits records were studied and this rather surprising discovery was made: of the 314 employees who have retired from the Humble Companies, 257 received monthly benefit checks on June 30. This represents approximately 82 per cent of all persons retired by Humble, and seems to dispel the thought occasionally expressed that annuitants do not live long to enjoy their retirement benefits.

Annuitants to be interviewed were selected at random from the list of 257, care being exercised only that one or more be included from each major branch of the Companies' operations. Admittedly, emphasis was placed on seeing a high percentage of those annuitants who have been retired for a considerable number of years. The latter was done for a dual purpose: to point out that a majority of those who have retired from the Humble Companies have lived to enjoy their annuity benefits for many years; and to gain the benefit of the wisdom of these experienced annuitants.

One of the first annuitants interviewed was a former pumper in the Production department, John Yielding, whom we found busily engaged in canning peaches at his home near Olden, Texas.

"I don't really need these peaches," he said, pointing to a pantry which contained some 300 jars of preserved fruits and vegetables, "but they are too ripe to sell, and I don't like to see them go to waste."

Mr. Yielding, approaching 76, lives with a bachelor son in a comfortable home set at the front of a five-acre orchard of peach, plum, and apple trees. With wisdom and forethought he had purchased the small tract and had set out the trees well ahead of his retirement, so when the time came to say farewell to his work with the Company the orchard was an outlet for his energy and was producing an income to supplement his annuity benefits.

"You see, I had worked all my life and had raised a family of seven, and I knew I couldn't quit suddenly. I wanted something to do. The orchard and garden keep me busy, and the work isn't too hard for me," he said.

While we sat and talked several fruit customers drove in.

inquired about peaches, proceeded at his suggestion into the orchard to pick as many as they wanted, and dropped back by the house to pay Mr. Yielding. Placing the money in a worn purse he said: "I'm not rich, but I own this place and I don't owe any man a dime. What I get from my annuities and what I make from the orchard I can do with as I please, and my boy and I get along comfortably here on that."

On the subject of the Humble Company and its annuity plan he spoke emphatically: "Humble is a fine Company, and if today's employees want to know what the old retired folks think, you can tell them for me: 'Take advantage of all the good things offered.' "

Passing over into Humble Pipe Line Company circles, the logical annuitant to see first was Frank W. (Daddy) Reese. who is approaching the ripe old age of 80, erect, alert and active. In his big two-story brick home at 2226 Binz Street, Houston, where he has lived alone since the death of Mrs. Reese in 1940, he recalled vividly many of the highlights of his career of more than 47 years in the oil industry. From the days when he began as a pumper's helper in West Virginia in the middle 80's, to the time of his retirement as superintendent of the Southern Division, Humble Pipe Line Company, on January 1, 1934, Daddy Reese said he always thought in terms of preparing for the days of his retirement. Work in the oil fields and on pipe lines was hard in the early days, and knowledge of the retirement plan and the thought of better days ahead, he said, softened many of those hardships.

Speaking from the depth of his experience and his background of almost 12 years of pleasant retired life, he passed along this epigram to employees young and old who are now active: "Start planning for tomorrow today, and tomorrow will be happier than you think."

Still another Pipe Line Company annuitant who finds life extremely good these days is David K. Warren, whom we found relaxing in a swing on the vine-covered front porch of his attractive rock home in the Hill Country west of Boerne. Welfare, Texas, is Mr. Warren's post office address. Very appropriate, it seems, for out there on his *ranchette* of four acres he and Mrs. Warren live the full life. Their home is modern in every respect and is located near a main highway where they can see the passing parade.

Mr. Warren spoke long and interestingly about his years with HPL; asked eagerly about friends and former associates; and explained that the Hill Country, where for some time before his retirement he had planned to settle down, is the ideal place to enjoy leisure time. "Life out here is fine," he said, "and that regular monthly annuity check means much toward making it so."

Asked if he had any suggestions to pass along to employees he fairly beamed. "You can tell them my advice is to put all they can into the Company plan and into War Bonds now . . . and if they find they have some extra cash from time to time. tell them to buy another $18.75 Bond every time they can."

The first woman annuitant to whom our path led was Mrs. Jennie M. Decker, who retired on January 1, 1936. Granddaughter of General Sam Houston and service mother, Mrs. Decker recently returned from a six-months travel tour for visits with her children and grandchildren in the service—a practice which she has followed for many years. Her son is a retired Navy officer; her daughter is married to a Colonel in the Army; and her three grandsons are also in the service.

When she retired after 18 years in the Sales department.

A DAILY WALK KEEPS MRS. PATTERSON IN GOOD HEALTH

JOHN YIELDING IS PROUD OF HIS FIVE-ACRE ORCHARD

Houston Office, Mrs. Decker said she first planned to go to work again after a brief rest. She laughingly asserted, however, that her grey hair was a handicap to that plan and that she is no longer interested because she is having too much fun doing other things, chiefly traveling.

Mrs. Decker said she did not plan for her retirement, and because of that she advises others to do so. Her admonition is to "study and understand the plan thoroughly" to help lay the pattern for retirement during working years and to insure a knowledge of what benefits may be expected when retirement age approaches.

Still another Houston Office annuitant visited was Clayton W. Carpenter, painter foreman in the Maintenance department until his retirement on October 1, 1936. Looking younger and more fit than many a man 20 years his junior, Mr. Carpenter still contracts for interior painting work, especially now that rationing has put an end to the avid desire for travel which he and Mrs. Carpenter share equally.

From the time of his retirement until gasoline rationing, the jolly couple had traveled approximately 100,000 miles in their car and house trailer, having missed only the New England states and Washington and Oregon in their ramblings. They have traveled as much as eight months out of a year, but today their compact trailer sits neatly on blocks in the middle of a large lot at 1821 Cortlandt Street, Houston, shaded by large pine trees. Here the Carpenters make their home, and while he handles painting work or makes and paints decoy ducks, Mrs. Carpenter knits for the Red Cross. Perfectly content with these occupations, they are, however, looking forward to the day when once again they can hitch their trailer home behind their automobile and "see what Uncle Sam has in these United States."

Although Mr. Carpenter was over-age at the time of his employment with the Company and was not eligible for Annuity Plan participation until the original plan was changed in 1930, he says that the savings accumulated to his credit during those last few years make his monthly check now sufficiently large to help out appreciably.

Up at Jacksonville, annuitant Ross Steele was seated by his radio, the spot where he might be found most any time, according to Mrs. Steele. Progress of American forces in the Pacific is close to his heart, because he fought in the Philippine Insurrection in 1900-01, and throughout the recent Philippine campaign and the battle for Okinawa he seldom missed a newscast. In addition to his interest in war news and in books and magazines he does as much gardening as he can manage on crutches.

Colonel Steele, as he has been known to his associates for many years, had prepared for retirement wisely by the purchase of an attractive rock home on a plot of about four acres some three miles from Jacksonville. However, he soon found that his partial disability would not permit him to handle the orchard, garden, and yard work, so he disposed of the place and purchased a comfortable home in Jacksonville.

"Get into the A & T plan as soon as you are eligible and stay in it through thick and thin and you'll win," he said. "My only regret is that I was comparatively old when I started with the Humble Company," he continued, explaining that even though he had enjoyed only 14 years in the A & T plan, he was happy and content with his monthly annuity check.

Mr. Steele's continued interest in the Humble Company is manifest by his frequent visits to the Jacksonville district office, Sales department, to see his former associates, and by

DADDY REESE APPROACHES 80, ERECT, ALERT, AND ACTIVE

D. K. WARREN enjoys the fish pool at his Hill Country home. "Put all you can in the Company plan," is the good advice of Annuitant Warren.

his reading of Company publications from cover to cover to keep up with the news.

Going into the realm of Refining department annuitants, the first interviewee was Mrs. Leona Patterson, whose retirement on December 31, 1938, ended a career of more than 19 years in that department, most of which time was spent as secretary to E. L. Fitzgerald, head of Refining accounting in Houston. From the time of her retirement until the death of her husband in 1942, she raised flowers and shrubs while her husband tended a vineyard in his spare time on their farm north of Conroe. He was an employee in the Houston office, but had not reached retirement age at the time of his death.

In recent years she completed a prodigous quantity of knitted goods for the Red Cross, an avocation which recently brought her a contract to knit articles for sale. Between knitting, growing flowers, and enjoying long walks with her bull terrier, "Peter," she has a program as full as most younger folks. A two-mile walk with the dog every morning before breakfast keeps her physically fit, she said, and actually she looks much too young to be an annuitant of six years.

"Go into the Plan the full amount," she advises employees. She said she participated from the very beginning of the Plan, and while she admits she was not consciously saving for her retirement but was participating "because it seemed too good a thing to skip," she is happy because annuities and stock dividends make up the bulk of a comfortable income.

When we drove up at the farm home of Doc Taylor, colored teamster at Baytown refinery until his retirement on January 15, 1937, we rather expected to see him seated on the cool front porch in the rocking chair presented him by fellow workers as a going-away gift some eight years ago. But such was not the case. He was not at home even, and his wife informed us that he was down in the Brazos River bottom making hay.

It was not until we approached the hay press and heard him say to his mules: "Whoa! and stay whoa," that we remembered him as the legendary character at Baytown refinery for some 16 years, "Ole Stay Whoa" Taylor, teamster deluxe.

"Just putting up a little hay for my livestock," he answered when we remarked that it was hot work that he was engaged in. "Got to keep doing something to keep from getting stiff. You know, a man just can't quit working all of a sudden." In spite of his 75 years, he is erect and apparently in good health. He keeps busy on his 30-acre farm near Brookshire, Texas, purchased while he worked at Baytown in anticipation of his retirement.

Doc Taylor is still very much interested in what goes on at Baytown refinery and in the Company. "Fine people and a fine Company—that's Humble," he said. "I'm just sorry I wasn't with 'em sooner and didn't get to stay longer." He bemoaned the fact that he no longer was able to purchase Humble stock on a regular monthly basis as he did during his active days, and advised colored employees everywhere in the Company to take advantage of good things offered them.

At the conclusion of our survey we reviewed the rare experiences we had been privileged to enjoy and sought to piece them all together into one complete picture. What we arrived at is this: The exciting yesterdays we lived through with these elderly employees and the happy todays we heard about and saw with our own eyes formed unmistakable evidence that their course is the course for active employees to steer if they would have happy tomorrows—tomorrows that are carefully planned today, tomorrows that will mean growing old gracefully, as they have done, and enjoying life fully. For we have seen that Humble annuitants live happily.

ROSS STEELE follows Pacific war news closely from his easy chair. "Stay in the Plan through thick and thin, and you'll win," he says.

AT 75 DOC TAYLOR MAKES HAY IN THE BRAZOS BOTTOM

INSPECTOR EMPLOYING A HIGH SENSITIVITY INDICATOR MAKES A ROUTINE TOXIC VAPOR TEST ON TOLUENE VESSEL

Inspectors

Skilled men, accurate equipment protect refinery employees from toxic and explosive gases

GRUDE oils, and the various components into which they are cut by refining processes, inherently contain vapors and gases that are either toxic or explosive, or both. Therefore, refining technologists and safety engineers have studied and continue to study gas detection and measurement with infinite care to protect employees, to make refineries some of the safest industrial plants in America.

One of the outstanding precautionary measures taken is the endless routine of checking units, vessels, and areas to determine the type and quantity of dangerous vapors present, if any, before employees begin work in or around those units or areas. On the basis of facts obtained in these tests by trained inspectors employing delicate and accurate detection equipment, precautionary measures and safety equipment are prescribed.

For detecting explosive gases, refin-

ery inspectors employ an exceedingly sensitive combustible gas indicator which records the slightest trace of such gas. If even a minute trace is indicated, no welding or open flame work is allowed until the condition has been remedied. When an area or vessel has been completely freed of explosive gas a permit known as an "OK for hot work" is issued.

Toxic vapors are detected in a similar manner to explosive gases, but the indicators employed are even more sensitive and record the presence of such vapors in parts per million.

In all gas test work the inspectors also test for hydrogen sulfide, a gas naturally present in almost all crude oils and their components. Presence of this gas is discovered by a small metal cartridge attached to the rubber intake tube of the combustible gas indicator. Developed by two Baytown inspectors, the cartridge contains a piece of blotter paper saturated with lead acetate which becomes discolored in the presence of

WHEN A TANK has been steamed and washed, one-half gallon of sediment is taken off bottom, placed in the ice cream freezer shown here and agitated. This test simulates the action of employees working in the sediment in the tank, and assures them full protection against gas formation resulting from agitation.

AN INSPECTOR CHECKS to make certain that all oil has been cleared out of the lines.

FOLLOWING TEST, INSPECTOR WRITES OUT AN "OK FOR HOT WORK" FOR WELDER

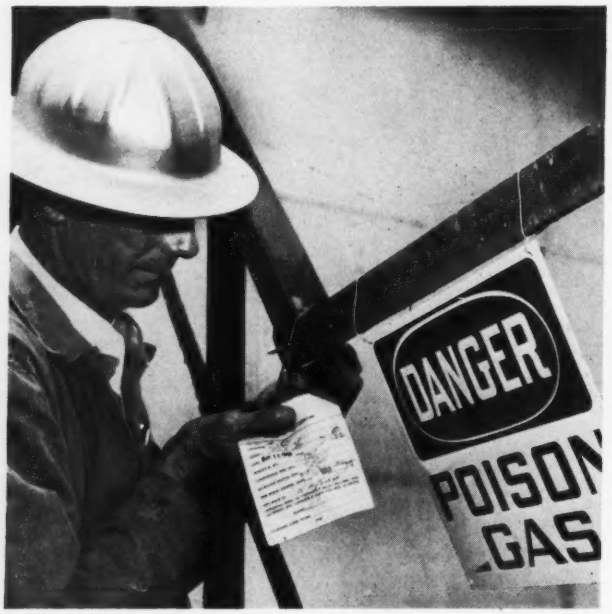
minute portions of hydrogen sulfide.

All gases detected by the inspectors in test work are determined in types and amounts. They make a complete report to the foreman in charge of the job in question and to the safety department, and from this report the mechanical and process forces and the safety engineers determine the proper types of safety equipment to be worn on the job and the safety precautions to be observed.

The inspector making each test writes all pertinent information on a card or certificate. His signature is supplemented by signatures of the mechanical supervisor or foreman and the process or operating department representative, and the certificate is then posted securely at the entrance to the vessel in question, or is displayed prominently on the unit or in the area tested.

To insure the safety of employees while work progresses, inspectors are often called back to make periodic tests, and in extreme cases an inspector remains on the job constantly, making continuous checks.

With the safety of fellow employees depending upon the thoroughness and accuracy of their work, the inspectors take each test assignment seriously and make all checks with infinite care. Their interest in better and more accurate test equipment has resulted in the perfection of several units now in use in Humble refineries.



TEST RESULTS ARE RECORDED ON A CERTIFICATE WHICH IS POSTED PROMINENTLY ON VESSEL OR IN AREA IN QUESTION

Third wartime assignment transforms Randolph Field, San Antonio, source of combat pilots and aerial instructors, into training ground for B-29 crews

PACIFIC VETERAN HOBO QUEEN NOW SERVES AS GROUND LABORATORY

Super SCHOOL

HUGE olive drab GI gasoline trucks which once rolled swiftly from plane to plane along the asphalt ramps of Randolph Field now make fewer trips—but stay much longer.

Today's patrons of the refueling crews are thirsty B-29's, vat-stomached Superfortresses which hold at one filling a railroad tank car of high octane gasoline. The aerial giants replaced smaller, lighter training planes at the West Point of the Air this spring when Randolph Field became one of the AAF Training Command's very heavy bombardment pilot training schools.

It is the third wartime job for the colorful air field located just a few miles outside San Antonio. Randolph's twin runways once produced annually the world's largest crop of basic combat pilots, the majority of whom are now veterans of action in World War II. Then AAF authorities moved to Randolph Field the Central Instructors' School, post graduate flying academy of the air forces. Until this spring Randolph produced aerial instructors in basic, single-engine and twin-engine advanced flying.

Now the single-engine and twin-engine trainers have given way to slim-bodied Superfortresses, each one a 135,000-pound aerial classroom for commanders, co-pilots and flight engineers learning the feel of the winged giants which already are flying in fearsome packs almost daily over the Japanese homeland.

Under Col. William J. Cain, director of training, a West Point graduate and veteran four-engine pilot, the AAF has assembled hundreds of standout experts in the arts related to very heavy bombardment. His executive officer is Major John B. Cunningham, Jr. Many of the B-29 transitional school staff members were basic flight students at Randolph Field during the West Point of the Air days.

Battle-decorated Superforts which spent the days of their youth bombarding enemy installations or buffeting the elements flying supplies over the Himalayas now serve as training planes at Randolph Field. And a number of flying veterans of the air war in the Orient occupy key positions in the transitional school.

Director of flying, for instance, is 30-year-old Lt. Col. Ed. Loberg, a battle pilot with 65-plus missions in the South Pacific and a dozen B-29 expeditions in the China-Burma-India theater on his record.

In fact, virtually the entire Pacific has been his battlefield. The big ex-farm boy from Tigerton, Wisconsin, was at the controls of a Jap-hunting B-18 the morning after he watched bombs bursting around Hickam iFeld on December 8, 1941. Within a week he had been checked out in a B-17 which he later piloted to the Solomons. As a First Lieutenant, Loberg flew a bomber over Guadalcanal a week before the Marines moved in, and later he piloted a Superfortress on the first B-29 raid on Tokyo.

It was during the battle for the Solomons that Colonel Loberg participated in a 44-minute aerial duel which was one of the great sky contests of World War II. Flying in weather

"calculated to hack any ordinary plane apart," Loberg's B-17 battled a Kawanishi 97, Nippon's premier flying boat, often with guns blazing at pointblank range, until the Jap ship plummeted into the sea after 44 minutes of gruelling air fighting.

Loberg heads a corps of precision-trained flying instructors who are preparing new waves of Superfort crews for battle action. Among the dozen or more combat veterans on the staff are Lt. Col. Joe Briley, flying safety and accident officer, and Major Gust Askounis, director of maintenance. Each of these officers, along with Lt. Col. Loberg, was at the controls of a B-29 in that first fleet of aerial giants which struck terror into the heart of Tokyo's residents and pioneered the new phase of aerial destruction which now dominates the Pacific.

Superfortress veterans of CBI action now at Randolph Field include Kickapoo II, a silvered craft with 42 black camels, each signifying a 2500-mile round trip across the Hump, stenciled proudly across her nose. Kickapoo II, in which most of the Randolph Field instructor's staff received their training, also has credit for two bombing missions, one against Yawata in Japan, another over Manchuria.

Standing alongside Kickapoo II is Ding How, still wearing the olive drab of battle paint, and displaying eight stenciled combat bombs and a long row of over-the-Hump camels.

Grounded forever but still serving the AAF, Hobo Queen is another doughty veteran of service which has earned her a bright row of 46 red camels strung over her fading war paint. Standing mutely in the shadow of Hangar K, Hobo Queen serves as a laboratory in which First Lt. J. A. Heaton teaches mechanics and other maintenance personnel the intimate secrets of the four 2200-horsepower engines which can carry eleven men and ten tons of bombs more than 300 miles per hour through stratospheric heights.

At Randolph Field future commanders, co-pilots, and flight engineers spend 50 hours aloft in their Superfortress classrooms, entering upon a unique team association which endures through the next and final phase of their training and ultimately into combat. Aerial training of flight engineers, a category peculiar to the Superfortress in the Army Air Forces, is under the direction of Capt. E. W. Schrage, a veteran four-engine instructor, and First Lt. A. C. Burnes, recently returned from his overseas job as a flight engineer in combat.

In the fleecy skies above Randolph Field the future B-29 commanders and their co-pilots learn what to do when the aerial dreadnaught's power plant fails in mid-air, how to cope with engine fires aloft and on the ground, how to abandon aircraft during flight and after crash landings, how to manipulate the giant craft with any combination of motors missing. Also in the curriculum are lessons in taking off and landing blind by use of instruments. All of the poten-

STILL WEARING the olive drab dress of combat, some of the battle scarred veterans require touching up. And what a job, when a tall ladder is necessary to get to the top of the huge tail assembly.

FROM AAF TRUCKS A TANK CAR FULL OF AVIATION GASOLINE USHE

tialities of battle damage were carefuly taken into consideration in planning the course of instruction for these men who expect some day to participate in the ultimate crushing of the Nipponese.

"Training of the three-man team at Randolph Field is conducted in a unit insofar as practicable," points out Colonel Cain, "in order to stimulate crew coordination, morale and the sense of mutual responsibility."

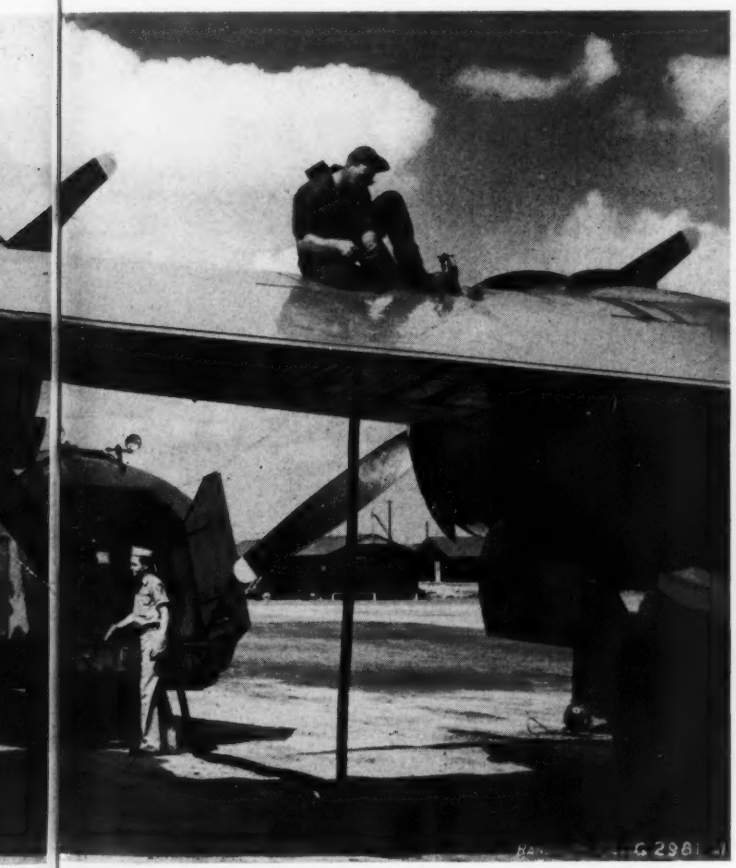
Flight engineer students, most of them fresh from flight engineering schools of the AAF Training Command, arrive at Randolph Field three weeks ahead of the beginning of their five-week aerial course in order to master an intensive course in practical airplane maintenance. Commanders and co-pilots join them during the third week of pre-flight instruction and from then on the three-man teams stick together through transition, their final phase of instruction at an air force installation and into combat.

In addition to their 50 hours in the Superfortress, student pilots and flight engineers spend some 95 hours in classrooms of the very heavy bombardment ground school operated under the direction of Major Ross F. Rogers. Engineering and flight planning, the latter a stiff course with classroom problems involving normal and emergency conditions of operation under varying situations of load, weather and navigation, loom high on the ground school schedule. Other subjects presented by Major Rogers' instructors, 60 per cent of whom have the dual rating of pilot-engineer, include a complete study of radio equipment and the fundamentals of radar, proper loading of the B-29, aural and visual code sending and receiving, aircraft and naval vessel recognition and a resume of such personal equipment as the oxygen system and fire extinguishing mechanisms.

Lively demonstrations of what goes on inside the vitals of a mission-bent B-29 feature the Randolph Field classrooms, with operating mockups prepared by First Lt. Doyle W. Bunch and CWO Y. H. Young being utilized in ground school training. Gasoline sluices through a glass-panel fuel system so that the student can see just how the arteries of the aerial giant keep the four 18-cylinder motors roaring. An impressive display strips the Superfort's brakebands bare so that a student may step on a classroom pedal and watch the braking system go into action. Such training aids as these, reasons Major Rogers, help a future pilot or engineer cope with mechanical difficulties in operational areas.

Finishing their transitional training at Randolph Field, the three crewmen become a well-fused team, ready to pick up the remaining members of their eleven-man B-29 crew at the next phase of training.

OLINE USHES INTO THE TREMENDOUS WING TANKS OF A SUPERFORTRESS



ALTHOUGH THE picture shows a distorted view, an appreciation of the size of the Superfortress may be gained by comparing the size of the student mechanics standing by the front landing wheels.

IN THE SERVICE

☆ ☆ ☆ ☆ ☆

It almost seems these are homecoming days around the Humble Companies, what with so many long-gone, familiar faces showing up for visits. Of course the visits are all too brief, usually just a howdy-and-on-to-the-Pacific affair, but it is good to get first-hand information from Humble's fighting men. Too, usually they have news of other Company men met along the roads of war, and whether the news comes by word of mouth, postal service, telephone or telegraph, the folks back home always are eager to get it.

One recent visitor to the HUMBLE WAY office telling of his close call with the enemy was *Elmer A. McClain*, WT 3/c, of the Navy, who was aboard the heavy aircraft carrier, *USS Franklin*, when it was set afire by enemy aerial bombs about 60 miles off the Japanese mainland. On duty in the fire room at the time of the attack, he was overcome by smoke, but escaped further injury. He entered the Navy March 20, 1944, and had been on the Franklin for the past year . . . After eight months of combat flying with the 321st Bomb Group in Italy, *First Lieut. Jack J. Valenti* of the Sales-Publicity department, visited in Houston recently preparatory to reassignment, additional training and then a likely trip to the Pacific. Lieutenant Valenti, who has been in the Army for more than two and a half years, piloted a B-25 in Italy. He has the Distinguished Flying Cross, the Air Medal with four Oak Leaf Clusters, and the Distinguished Unit Badge with one cluster . . . Back on stateside duty for recuperation, rehabilitation and recovery before reporting at Tampa, Florida, is *Lieut. James R. Leggett*, who has been in England since August, 1943, in the combat intelligence division of the Eighth Air Force's famous 91st Bombardment Group. Lieutenant Leggett, who was with the Secretary's department before he was called into active service as a National Guardsman in November, 1940, was commissioned from Officers Candidate School in January, 1943 . . . Also returning to the United States recently was *Lieut. Horace Coon, Jr.*, after piloting a large Navy flying boat on 251 combat patrols during his recent tour of duty with a patrol bombing squadron operating from Naval bases in Central America and the Caribbean. His squadron, which served overseas 16 months, now will receive additional training and eventual reassignment. He was employed at Lovell Lake with the Production department when he entered the Navy in December, 1941 . . . From headquarters of the Twelfth Air Force comes a news release to the effect that *First Lieut. John M. Ford* has been

BRIG. GEN. R. D. KNAPP AWARDS LIEUTENANT VALENTI DFC

M/SGT. D. C. LAMM SUPPLIED GASOLINE TO 15TH AIR FORCE

ELMER A. McCLAIN, WT 3/c

awarded the Distinguished Flying Cross for extraordinary achievement while participating in an attack upon a railroad bridge at Pordenone, Italy, a feat which displayed great courage and superior flying ability. Veteran of more than 70 combat missions, Lieutenant Ford has the Air Medal with seven Oak Leaf Clusters, two battle stars and the Distinguished Unit Badge. He was junior accountant in the Production Accounting department before entering the Army September 5, 1942 . . . *Lloyd O. Zapp*, executive officer of the 408th Engineer Service Battalion in Italy, has been promoted from captain to major. according to a release from Peninsular Base Headquarters. A civil engineer for the Gulf Coast division of the Production department before entering military service in April, 1942, he had been a cavalry reserve officer since 1934 . . . The Bronze Star was presented to *Sgt. R. A. Brand, Jr.*, in Memorial Day services in Germany for "the unselfish loyalty, leadership and skill displayed by him which reflects the highest credit upon himself and the armed forces of the United States." Employed in the Production department at Wichita Falls when he went into the service March, 1942, he has been overseas since February, 1944. Wearer of the combat infantryman's badge, he has been in five major campaigns . . . From headquarters of a pipeline engineers unit in the European-African-Middle Eastern theater comes word that *Master Sergeant Dudley C. Lamm*, a pumper for Humble Pipe Line Company at Anahuac station before entering the service September 25, 1942, is also an oil man in the Army. He has done an outstanding job as construction and operation foreman for an Engineer Petroleum Distribution Company which supplied 100-octane gasoline for the heavy bombers of the 15th Air Force . . . According to a release from an Army hospital in Hawaii, *Technician Fifth Grade Curtis C. Cox*, who was with the West Texas Division office in Midland when he went into the Army March 5, 1943, is convalescing there after becoming ill in the Saipan operation with the Combat Engineers. At this hospital, which specializes in the care and reconditioning of men whose progress toward recovery permits a supervised schedule of exercise, training, classroom study, gardening or handicraft, Technician Cox is taking advantage of the opportunity to prepare himself for further service in the Army or in civil life . . . Recent visitor in THE HUMBLE WAY office was *Capt. Edward N. Gideon* of the Army Air Corps. He has been transferred from the Del Valle Army Air Field near Austin to duty in Florida. Employed with the Production department at New London, he went into the Army July 20, 1942.

LIEUT. JAMES R. LEGGETT

CAPT. EDWARD N. GIDEON

Staff Sgt. Oren Eskew Returns

On July 25, his fifteenth wedding anniversary, Staff Sgt. Oren Eskew, recently home from Europe, walked into the HUMBLE WAY office with his wife. Sergeant Eskew, operator for fifteen years of Humble Service Station 177 at Bastrop, had been overseas since November, 1944 and was reported missing in action on January 6, 1945.

After a delay of some weeks, his wife, who had operated Station 177 since Sergeant Eskew's entrance into the service in September 1943, received word from him in a prison camp near Stuttgart, Germany. He was liberated soon after V-E Day and returned to Bastrop on June 7 for sixty days rest and recuperation.

During his stay in Bastrop, Sergeant Eskew renewed old acquaintances and was delighted to find that in his absence his wife had operated his service station in a most efficient manner. It is Sergeant Eskew's earnest desire to return soon to his old position and carry on where he left off two years ago.

STAFF SGT. OREN ESKEW

By the way . .

RALPH J. SCHILTHIUS returned to the Company on August 1, after having spent four years in Washington, D. C., as assistant director of the production division of the Petroleum Administration for War. He has taken over the post of division engineer of the Southwest Texas division, Production department.

S. V. JAY, lubrication engineer in the Sales department, recently was elected vice president of the Texas section of the Society of Automotive Engineers.

H. M. KRAUSE, JR., chief district engineer at Wink, Production department, was named senior petroleum engineer in the Houston office on July 15. Succeeding him at Wink is STEVEN J. LEACH, associate petroleum engineer in the West Texas division office at Midland, and succeeding Mr. Leach is ELMO L. WALLING, formerly in the Houston office.

JOHN F. BRICKER of the Geologic, Lease & Scouting department on July 1 was named chief scout for the Company, succeeding the late Dell J. Crosby who died on June 17. Mr. Bricker began his career with Humble in 1928, served for a number of years as scout in West Texas and New Mexico, and has been in the Houston office since 1940.

DR. H. T. ENGELHARDT, graduate of the Tulane University School of Medicine, on June 1 became a member of the Medical department staff in Houston. Following graduation from Tulane in 1937, Dr. Engelhardt served his internship at Santa Rosa Hospital, San Antonio, and practiced in that city for a short time before returning to his Alma Mater in 1939 as a faculty member.

Annuitants

T. R. HANRAHAN, superintendent of the Southern Division, Humble Pipe Line Company, became an annuitant on July 2, closing out 25 years of service with Humble and a career that adds up to 51 years in pipe line work. Back in June of 1894, at the age of 14, Mr. Hanrahan began work for the Indiana Pipe Line Company, remaining there until 1911. At that time the subsidiary in which he was working was purchased by Sinclair Pipe Line Company and he remained in that organization until coming to Humble Pipe Line Company on August 16, 1919. A barbecue and retirement party given in his honor on July 7 at Pine Haven, near Tomball, was attended by some 400 of his associates and friends. A. E. PAYNE, assistant to Mr. Hanrahan for a number of years, has been named superintendent to succeed him.

RAYMOND TEBBETTS, district construction foreman in the Friendswood district, Production department, retired on July 16 after more than 20 years with Humble. At a safety meeting in the community house on the day of his retirement, friends and associates presented Mr. Tebbetts a gold watch.

JOHN C. ROBERTSON, civil engineer in the Humble Pipe Line Company engineering department, reached age 65 and became an annuitant on July 30. Mr. Robertson came to the Pipe Line Company as chief draftsman on March 25, 1919. As a farewell gift, friends in the department gave him a gold watch.

The HUMBLE WAY

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Published every other month for employees and stockholders

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P. O. Box 2180, Houston 1, Texas

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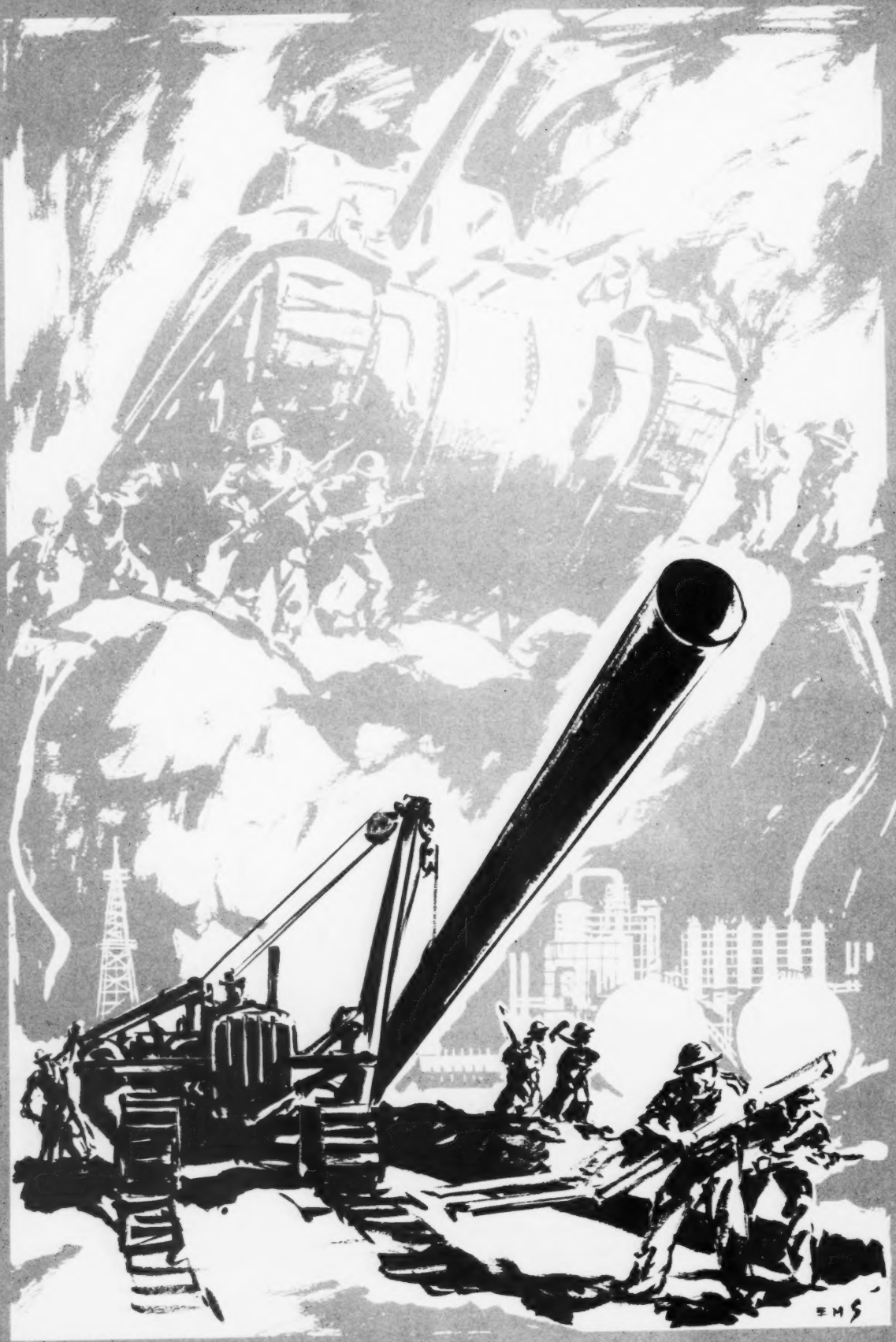
Deaths

DELL J. CROSBY, 44, chief scout for the Company, died on June 17 in Houston, ending his career of more than 15 years with Humble. He was well known in Texas oil circles, and was a past president of the National Oil Scouts and Landmen's Association.

BERT D. DOSS, 54, West Texas field clerk for Humble Pipe Line Company, died at Midland on June 28. He had been with HPL since June 19, 1927, when he was employed as a telegraph operator at Sonora.

DAVID DUNLOP, 43, draftsman in the civil engineering section, Gulf Coast division, Production department, died at his home in Houston on July 26. He had been with Humble since March 7, 1929.

THIS ATTRACTIVE pattern of horizontal and vertical lines, of lights and shadows, is formed by the end of a water cooling tower at Baytown refinery.

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